

REMARKS

Favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Minor editorial changes have been effected to the specification which are self-explanatory.

The claims have been revised into compliance with U.S. practice, as well as to include the amendments kindly suggested by the Examiner in item 1 on page 2 of the Action.

Claims 1-4 are rejected under 35 USC 103 as being unpatentable over Shioya et al. (USP 5,928,776) in view of JP 10-077359. This ground of rejection is respectfully traversed.

The Examiner objects to claims 1-4 as unpatentable over Shioya et al., on the basis that the compressive hardness of the cushioning layer is inherently present in the Shioya et al. cushioning layer.

However, the inventors of the present invention have conducted extensive experiments changing the expansion magnification and thickness of the cushioning layer to obtain an excellent surface quality. As a result, the inventors found that, when the compressive hardness is 0.1MPa or greater, the contacting power between the cushioning layer and the core layer of the foam particles is enhanced, and the fusion-bonding is improved. Thus, when the compressive hardness is set at 0.1 MPa or greater, no contraction or thermal deformation of the surface is produced, thereby to obtain an excellent surface quality.

The compressive hardness of the cushioning layer is a characteristic of the cushioning layer which is determined by a very complicated relationship between the composition, melting point, foaming magnification and the like of the base resin of the cushioning layer. The compressive hardness cannot be determined merely by knowing the gel ratio and melting point of the cushioning layer. In other words, there are many cases where even though the cushioning layers have the same gel fraction ratio and melting point, their compressive hardnesses are different. For example, referring to Table 1 (page 24 of the present specification), both Comparative Examples 1 and 2 have a gel fraction ratio of 35% and a melting point of 138°C, however their compressive hardnesses are different i.e. 0.05 MPa and 0.08 MPa, respectively.

For the Examiner's information, enclosed is a copy of Table 1 of the present specification with a gel fraction ratio data included, for each Example.

In view of the above-mentioned situation, it cannot be said that the compressive hardness of the cushioning layer of the present invention is inherently taught by the disclosure of Shioya et al.

Even if it is assumed that the compressive hardness of the present invention is included in the teaching of Shioya et al., there is no teaching or suggestion in Shioya et al. which would motivate the artisan to select the specified compressive hardness of the present invention.

There is no teaching or suggestion in the art that the compressive hardness of the cushioning layer is a critical feature in producing an excellent automobile molding composite.

Moreover, it is not easy for one of ordinary skill in the art to optimize a range of numerical values of the compressive hardness. This can be well supported by the fact that, as discussed above, even when the cushioning layers having the same gel fraction ratio and melting point, they have different compressive hardnesses.

Further, based on the numerical limitation of compressive hardness recited in the claims of the present application, the principal object of this invention, the improvement of surface quality, which is not disclosed by Shioya et al., can be achieved. This is an excellent and conspicuous advantage which clearly distinguishes the present invention from Shioya et al.

The Examiner also takes the position that the foaming layer, which comprises a foamed state of core layer of a PP resin, and a thermal plastic resin foaming particles (hereinafter called "sheathed core beads") consisting of a substantially non-foamed state of PE coating layer for coating the core layer, is the same as that of JP '359, and, therefore, has no novelty. However, the inventors of the present invention had found, during their careful study of various foaming particles, that, rather than the other PP foaming particles, the sheathed core beads which can be molded at a rather low temperature can provide the effect of compressive hardness of the cushioning layer which is the essential feature of the subject matter of the present invention. When the other PP foaming particles, which require a higher molding temperature, are used, the cushioning layer having a greater compressive hardness should be used. The importance of this

critical feature in producing an excellent molding composite is not disclosed or suggested by Shioya et al.

Further, in performing the compression filling, the compression ratio is preferably 1-50%. As the compression ratio becomes higher, the contact areas between the foaming particles become larger to provide a better fused-bonding. In addition, the compression reaction force possessed by the foaming particles become greater, so that the pressure force between the cushioning layer becomes greater to provide a better fusion-bonding between the foaming layer and the cushioning layer. However, the ordinary foaming particles require a higher temperature for fusion-bonding between the foaming particles. Still further, when the compression ratio becomes higher, the heating temperature needs to be increased. This is due to the fact that the pressure force between the foaming particles becomes excessively greater so that steam is difficult to pass through particles. When a heating pressure is increased (and the temperature is increased), the surface of the PP resin and the cushioning layer become deformable, resulting in producing deformation and contraction on the surface. To prevent this defect, the inventors found that the sheathed core beads, which can be molded at a low temperature, is useful.

In view of the foregoing, it is respectfully submitted that the claimed invention is patentably distinct and not obvious from the teachings of the cited reference. Accordingly, favorable reconsideration and allowance is solicited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Respectfully submitted,

Masaaki YOKOYAMA et al.

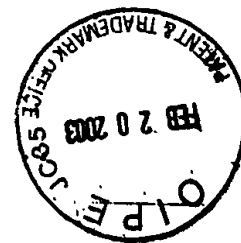
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Table 1

	Example 1	Comparative Example 1	Example 2	Comparative Example 2	Example 3
The resin of the core	ET-PR	ET-PR	ET-PR	ET-PR	ET-PR
Melting point (°C)	153	153	141	141	153
The resin of the coat	M-LLDPE	M-LLDPE	LLDPE	LLDPE	M-LLDPE
Melting point (°C)	100	100	123	123	100
Average bulk density (Kg/m ³)	45	45	42	42	50
L/D ratio	0.9	0.9	1.5	1.5	1.2
Average particle diameter (mm)	2.5	2.5	2.2	2.2	2.4
The state of the core	Expanded	Expanded	Expanded	Expanded	Expanded
The state of the coat	Substantially non-expanded	Substantially non-expanded	Substantially non-expanded	Substantially non-expanded	Substantially non-expanded
Polypropylene resin expanded sheet					
Melting point (°C)	143	138	143	138	146
Thickness (mm)	2.0	2.0	2.5	2.5	1.5
Expansion magnification (times)	20	25	15	20	11
Compressive hardness (MPa)	0.11	0.06	0.17	0.08	0.13
gel fraction (%)	57	35	35	35	50
Heat molding temperature (°C)	130	130	128	128	125
Compression ratio (%)	15	15	25	25	30
Fusion-bonded condition	○	×	○	×	○





Thus, this process provides such a mold.

5 However, the hitherto mold producing technique needs high temperature or high pressure steam heating when expanded resin particles are fusion-bonded. This leads to a drawback that surface quality of a surface layer is deteriorated by heat ^{upon} ~~when~~ heating. Therefore there is another drawback that when a design as an interior decoration member is formed on the surface of a surface layer, the design becomes difficult to predominate. There is also another problem that if molding is carried out at a low temperature, fusion-bonded between expanded resin particles is deteriorated and adhesion of the surface layer and the foam layer and of the foam layer and the base member are also deteriorated.

Furthermore, the above mentioned hitherto molding composite producing technique requires to heat for a long time by a high temperature steam in order to increase adhesiveness between a sheet for a surface layer and expanded resin particles. Because of this condition, when fusion-bonded by heating is conducted, much moisture in the gas state infiltrates into spaces between expanded resin particles or into particles themselves. If cooling is carried out under this condition, moisture condenses from the gas state to the liquid state, thereby causing great volume shrinkage.

On this account, pressure in the spaces between expanded resin particles or in the particles themselves reduces, thereby causing shrinkage or deformation of an expanded mold made of these particles.

the heating temperature when expanded resin particles are molded is set at a lower temperature. Furthermore, concerning the coat, an ethylene polymer having a melting point of 10°C or more lower than that of the polypropylene resin constituting the core may be preferably selected and used.

If the above melting point difference is smaller than 10°C , under the condition that the polypropylene resin of the core is expanded, the coat made of the polyethylene resin is also likely to be expanded.

The above coat is preferably a mixture of the above polyethylene resin and a polypropylene resin that is the same kind as the core. This leads to improvement of adhesiveness between the coat and the core.

21 The blending content of the polypropylene resin in the coat made of a polyethylene resin is selected from the range from 1 to 100 parts by weight, preferably from 1 to 50 parts by weight for 100 parts by weight of the polyethylene resin. If the blending content of the polypropylene resin is smaller than 1 part by weight, effect of improvement of adhesiveness between the core and the coat is low. If the blending content exceeds 100 parts by weight, since the ~~sea~~^{matrix} and ~~island~~^{domain} conformation of the coat in which the polyethylene resin makes a continuous layer changes, the polypropylene resin constitutes a continuous ~~sea~~^{matrix} phase. On this account, the heating temperature when molding cannot be lowered.

for fusion-bonded of the coat by melting the coat without melting the core that has a higher melting point than the coat. A resin molding composite in which expanded resin particles themselves, and a foam layer and a cushioning material are fusion-bonded can be obtained by pressing and fusion-bonding the coats with each other using a compression repulsion that the core has.

The above mentioned expanded resin particles has a composite structure that is constituted by a core that is in an expanded state and is made of a polypropylene resin, and a polyethylene resin coat covering the core that is in a substantially non-expanded state. The core in an expanded state, for example, has a closed cell structure or an open cell structure, and a closed cell structure is preferable. The reason is because a closed cell structure has a high compression repulsion of the core when molding since a closed cell structure is made of many closed cells, and compressive strength is high even at a low density. Closed cell ^{ratio} ~~rate~~ of the core is preferably 50% or higher, and more preferably 70% or higher. This makes a compression repulsion of the core when molding further higher, and a resin molding composite of which compressive strength is high even at a low density can be obtained.

Since the expanded resin particles for use in the present invention can be fusion-bonded at a low temperature, when the particles are filled in a mold and fusion-bonded using a comparatively low temperature and low pressure steam, infiltration

laminate comprising a surface layer and a cushioning material. The surface layer is formed by a polypropylene resin sheet. The cushioning material is formed by a polypropylene resin expanded sheet having a compressive hardness of 0.1 MPa or higher.

Polypropylene resins mean resins having a propylene content of 50% by weight or greater, such as propylene homopolymer, ethylene-propylene random copolymer, ethylene-propylene block copolymer, ethylene-propylene-butene random terpolymer, propylene-vinyl chloride copolymer, propylene-butene copolymer, and propylene-maleic anhydride copolymer. These resins are used singly or combined with two or more kinds of the resins.

In this case, as a polypropylene resin, which is a main ingredient, a resin having a melting point of 130°C or higher is desired in order to give a resin sheet and an expanded sheet heat resistance. From the standpoint of enhancing soft touch feeling, as a main ingredient polypropylene resin, it is preferable to use a single resin or a mixture of two or more kinds of resins selected from ethylene-propylene random copolymer, propylene-butene random copolymer, and ethylene-propylene-butene random terpolymer.

20 For the purpose of giving further soft touch feeling^{to} a resin sheet and an expanded sheet, other polymers or copolymers may be blended as a secondary ingredient with a main ingredient polypropylene resin. As such a secondary ingredient, a polyolefin polymer or copolymer is preferable, and particularly preferably

one or more than one polyolefin polymers or copolymers selected from polyethylene resins such as linear ultra-low density polyethylene, branched low density polyethylene resin, linear low density polyethylene resin, middle density polyethylene resin, and high density polyethylene resin; polyolefin elastomers such as ethylene-propylene rubber, ethylene-butene rubber, ethylene-octene rubber, and propylene-butene rubber; and polybutene resin. For the purpose of enhancing soft touch feeling of a resin sheet and an expanded sheet, if such a polyolefin polymer or copolymer has a melting point, the melting point is lower than 140°C, preferably 135°C or lower, and desirably 130°C or lower.

This polypropylene resin is preferably non-crosslinked, and may be crosslinked with peroxides ^{by irradiation} ~~or radioactive rays~~.

A typical process for producing a polypropylene resin expanded sheet is as follows. After melt-kneading a propylene resin with a pyrolytic expanding agent and, if necessary, various additives in an extruder at a temperature at which the expanding agent is not substantially pyrolyzed, extrusion is carried out to produce an expandable sheet. Then an expanded sheet is obtained by heating the sheet over a temperature at which the expanding agent of the obtained expandable sheet is pyrolyzed.

As a polypropylene resin, a mixture of a polypropylene resin with other thermoplastic resins that is miscible with a polypropylene resin may be used. Specific examples of such a thermoplastic resin

when molding are desired, therefore accordingly a grain pattern of the surface layer (surface pattern) is not erased. Furthermore, there is an effect that the surface layer and the foam layer do not come off with a lapse of time.

In order to exert these effects and to keep a shape of the cushioning material itself when molding, a cushioning material having a compressive hardness of 0.1 MPa or higher is selected.

As a base member made on the other side of a surface layer, a comparatively hard polyolefin resins are generally used. This base member is generally used for shape keeping or as a fixation keeping portion against other things such as a automobile body and the like. Since this base member is not exposed outside, it is not necessary to care about surface patterns and the like of the base member.

Concerning materials of the base member, considering its adhesiveness with a foam, polyolefin resins are preferably used.

If a foam, a surface layer and a base member are all constituted by polyolefin resins, it is preferable because ^{recycling}~~regeneration~~ can be easily conducted when retrieved things are crushed and ~~recycled~~.

A general molding method is as follows. After expanded resin particles are filled in a mold in which a surface layer and a base member is respectively placed, heating is carried out by passing steam through the spaces between the expanded resin particles filled in the mold, thereby fusion-bonding the expanded resin particles.

was kneaded, and using a single screw extruder having an inner diameter of 26 mm, a linear low density polyethylene (melting point 100°C) that is polymerized with a metallocene catalyst having a density of 0.907 was kneaded. Subsequently, ethylene/propylene random copolymer was used for a core and linear low density polyethylene was used for a coat, and a strand was extruded from a die having a die orifice of a diameter of 1.5 mm.

After cooling this strand by passing through a water tank, the strand was cut so as to have 1.2 mg of the average weight. The cross section of this composite particle was observed with a phase contrast microscope, and it was found that linear low density polyethylene of thickness of 30 μm covered ethylene/propylene random copolymer.

Next, in a closed vessel, 100 parts by weight of the above mentioned composite particles, 250 parts by weight of water, 1.0 part by weight of calcium tertiary phosphate having particle diameters of 0.3 to 0.5 μm , and 0.007 parts by weight of sodium dodecylbenzenesulfonate were placed. Subsequently, 13 parts by weight of butane was supplied into the closed vessel with stirring. After the contents were filled at a filling ^{ratio} ~~rate~~ of 62%, temperature was elevated for an hour until a temperature of 145°C was reached and the temperature was maintained for 30 minutes.

Subsequently, the releasing valve in the bottom of the closed vessel was opened, and at the same time nitrogen gas was introduced

in the mold, was heated to 130°C by steam to fusion-bond expand resin particles. After that, the product was cooled, and a molding composite was taken out from inside the mold. The bulk density of the foam layer was 53 Kg/m³, the size of the molding composite was 200 mm in length, 300 mm in width, and 40 mm in thickness. The shape was just the same as the mold without shrinkage and deformation in the surface layer.

(Comparative Example 1)

14 A molding composite was obtained in the same manner as in the above Example 1. In this case, as shown in Table 1, a polypropylene resin expanded sheet having expansion magnification of 25 times, compressive hardness of 0.06 MPa, and melting point of 138°C was used as a cushioning material. Concerning the molding composite taken out from inside the mold, although the ~~form~~^{foam} layer was adhered and integrated with the surface layer, there was shrinkage, deformation or the like in the surface layer.

(Example 2)

A molding composite was obtained in the same manner as in the above Example 1. In this case, ethylene-propylene random copolymer having a melting point of 141°C and linear low density polyethylene having a melting point of 123°C were used, and expanded resin particles of an average bulk density of 42 Kg/m³ was obtained. L/D, a ratio of a long diameter L and a short diameter D of an expanded resin particle was 1.5, the average particle diameter thereof was 2.2

mm.

As in Example 1, after these expanded resin particles were compressed and filled in a breathable mold in which a surface layer (as shown in Table 1, a polypropylene resin expanded sheet constituting cushioning material had thickness of 2.5 mm, expansion magnification of 15 times, and compressive hardness of 0.17 MPa) and a base member were respectively placed, surface temperature of expanded resin particles was heated to 128°C to fusion-bond expanded resin particles. A molding composite taken out from inside the mold has good appearance. The shape was just the same as the mold without shrinkage and deformation in the surface layer.

(Comparative Example 2)

18 A molding composite was obtained in the same manner as in Example 2. In this case, as shown in Table 1, a polypropylene resin expanded sheet having expansion magnification of 20 times, compressive hardness of 0.08 MPa, and melting point of 138°C was used as a cushioning material. Concerning the molding composite taken out from inside the mold, although the ^{foam}~~form~~ layer was adhered and integrated with the surface layer, there was shrinkage, deformation or the like in the surface layer.

(Example 3)

A molding composite was obtained in the same manner as in the above Example 1. In this case, the average bulk density of expanded resin particles was 50 Kg/m³. L/D, a ratio of a long diameter L

What is claimed is:

(Amended)

1. A polypropylene resin molding composite for ^{an} automobile, comprising a surface layer and a foam layer, or a surface layer, a foam layer, and a base member, wherein ^{comprises} the surface layer ^{comprising} a surface layer of a polypropylene resin and a laminate of a cushioning material, and the cushioning material ^{is} ~~being~~ a polypropylene resin expanded sheet having a compressive hardness of 0.1 MPa or higher, and wherein ^{comprises} the foam layer ~~being~~ thermoplastic resin expanded particles, ^{the particles} ^{which} comprising a core ~~that~~ is made of a polypropylene resin and is in ^{which covers} an expanded state, and a polyethylene resin coat ~~covering~~ the core and ^{is} in a substantially non-expanded state.

(Amended)

2. A polypropylene resin molding composite for ^{an} automobile according to claim 1, wherein ~~average particle diameter of the~~ ^{have an average particle diameter of} thermoplastic resin expanded particles ^{is} 1.5 to 4.0 mm.

(Amended)

3. A polypropylene resin molding composite for ^{an} automobile according to claim 1 or 2, wherein the polyethylene resin coat has a melting point lower than the polypropylene resin of the core, or ~~is a polyethylene resin that~~ substantially exhibits no melting point.

4. A polypropylene resin molding composite for automobile according to claim 3, wherein the melting point of the coat is 10°C or more lower than the melting point of the polypropylene resin constituting the core.